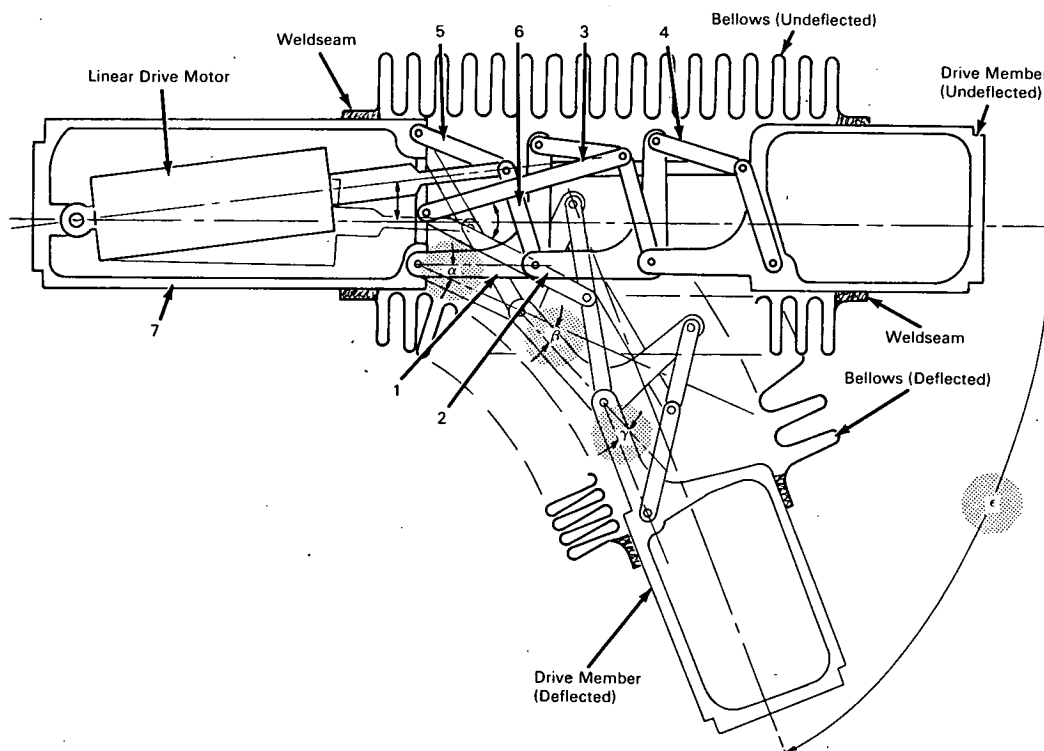


NASA TECH BRIEF



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Conceptual Hermetically Sealed Elbow Actuator



The general purpose of this concept is to provide for an electrically or hydraulically powered, hermetically sealed angular or rotary actuator that will deflect mechanical members over a range of $\pm 180^\circ$. Existing rotary actuators must use dynamic seals at torque input or output shafts, because the relative motion is too large for hermetic sealing by means of bellows-type flexural members. Dynamic seals are subject to wear and leakage. The use of such actuators under severe environmental conditions, as in the vacuum of space, or the salt water environment in the ocean, or in other severe chemical and temperature

environments is presently restricted to the endurance of the dynamic seals. The motion of flexural enclosures such as bellows and flexible hoses has to be restricted to the elastic capability of the material they are made from. Metal enclosures such as stainless steel bellows are restricted to small deflections per convolution and therefore can only move with small angular changes of an actuator.

This actuator design would overcome the disadvantage of conventional devices by providing incremental flexures which keep the local deflection rate within elastic limits. The mechanical linkage would

(continued overleaf)

enable complete enclosure of the actuator by a hermetically sealed bellows. The mechanical arrangement of the actuator would produce the total angular deflection by incremental deflections, over a permissible radius within the flexing capability of the bellows. The device achieves this incremental deflection by the use of a number of angular multipliers 1 and 2, which are guided by blind actuator rods 3 and 4. The linear drive motor moves the linkage between arms 5 and 6. This motion rotates multiplier 1 over an angle α , which is compatible with the elastic capability of the bellows. The blind actuator rod 3 causes angular rotation of multiplier 2 over an additional angle β , which is within the permissible deflection range of the bellows and adds to the deflection α . Blind actuator rod 4 rotates the drive member over the angle γ , which is then deflected with respect to member 7 by the sum of the incremental deflection α , β , and γ to a total deflection ϵ . Total deflections of more than $\pm 180^\circ$ in the plane of the members or continuous rotation in a spiral mode can be achieved by adding angle multipliers to the joint, which are all actuated by the

linear motor actuator. The deflection rate between angular multipliers can be changed by changing the proportions of the blind actuators and their linkage. In this way, the curvature can be kept within tolerable flexure limits of the bellows. The curvature can also be incrementally changed from one to the other angular multiplier in order to achieve a desired geometry of the total bend or a desired displacement of the drive member during the operation of the actuator.

Note:

This device is in the conceptual stage only; neither a model nor a prototype has been built as of the date of this Tech Brief.

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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